

Are You Computing in the Clouds?

Understanding Cloud Computing

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FOR WEEKS NOW, THERE HAS BEEN TALK IN THE MEDIA ABOUT ICLOUD™ AND OTHER CLOUD SERVICES OFFERED BY AMAZON AND GOOGLE.

I recently did a preconference on cloud computing with Dennis Crain, senior research program manager for the Extreme Computing Group at Microsoft Research (yes, I am a Mac person, but I can work with PC people), so I am up to speed on the concept and can share some of the basics on its use in higher education, research, and health care.

What Is Cloud Computing? There are numerous definitions, but, as usual, I like to start with Educause's *7 Things You Should Know*: "Cloud computing is the delivery of scalable IT resources over the Internet, as opposed to hosting and operating those resources locally, such as on a college or university network" (2009). Hurwitz, Bloor, Kaufman, and Halper, in *Dummies.com* (2011), provide an easy-to-understand definition: "Cloud computing is a networking solution in which everything from computing power to computing infrastructure, applications, business processes to personal collaboration — can be delivered to you as a service wherever and whenever you need." The cloud refers to "the set of hardware, networks, storage, services, and interfaces that combine to deliver aspects of computing as a service."

For a more comprehensive view, the National Institute of Standards and Technology (NIST) defines cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (2011, p. 2). NIST further describes five essential characteristics of cloud computing. I have tried to simplify them as follows:

- **On-demand self-service** Access the necessary computing services (storage or server time) on demand, without necessarily human interaction with the cloud service provider.
- **Broad network access** Access cloud services from a variety of Internet-capable devices, such as laptops or smart phones.
- **Resource pooling** The cloud service provider uses what is called a multi-tenant model in which computing resources are pooled, assigned, and reasigned according to consumer demands. (You may be using computing resources from data centers across the world.)
- **Rapid elasticity** Consumers can purchase services that are scaled up or down, depending on need. (Although consumers may feel they have unlimited resources, there will always be a limit.)
- **Measured service** Cloud services usually operate according to a pay-per-use business model that allows their systems to leverage resource use.

THE ADVANTAGES Cloud computing, which is sometimes referred to as *utility computing*, has several advantages: a) Users tap into this utility, just as we tap into the electrical grid. b) There are cost savings. Information technology (IT) departments can meet user demands without worrying about capital expenses (servers), software licensing, and the labor involved in upgrading and maintaining software. c) Scalability allows for an IT depart-

ment to provide users with access to services when they need them and use them. (Often IT departments get requests for expensive computational software products, with no way to predict actual usage; the licensing agreement and supporting staff may be under- or overutilized.) d) The metrics of pay as you grow provide valuable data to examine usage. e) A user can access services from multiple devices, anytime and anywhere.

THE SERVICE MODELS To further understand the concept, it is important to know the three different service models.

- **IaaS (Infrastructure as a Service)** An organization or consumer does not need to own servers, hardware, or network capacity to operate the necessary service. A client, such as a university or an individual consumer, would access the infrastructure and pay on a per-access basis. Examples are Amazon's EC2 and GoGrid.
- **PaaS (Platform as a Service)** The organization or individual does not need to own the operating system or necessary supporting software to use the application. Rather, operating systems and associated services are delivered over the Internet without downloads or installation. Examples are Google App Engine and Heroku.
- **SaaS (Software as a Service)** In this software distribution model, applications are provided by the cloud service host and made accessible via the Internet. An example in higher education would be providing access to Gmail, instead of having a university email system for students.

DEPLOYMENT MODELS There are four deployment models: public, private, community, and hybrid. At this point, the *public cloud* is where the bulk of services are available. As the name implies, institutions or consumers have access to a public service and pay as they go. The *private cloud* is operated solely for an organization. As Metz (2010) notes, there is much debate as to whether a private cloud is really cloud computing since it does not meet all the essential characteristics of the cloud. The *community cloud* is shared by several organizations and, as Metz points out, is the least developed area. A consortium of schools might be a good example of a community cloud. Finally, organizations may choose to use a *hybrid cloud deployment model*, for example, a combination of private and public cloud computing. "Cloud Computing Explained" by Metz provides detailed information, along with video clips, to demonstrate these concepts.

Who Is Using Cloud Computing? In the *2009 Horizon Report*, Johnson, Levine, and Smith (2009) projected a one- to two-year horizon for the adoption of cloud computing. Nagel (2011) reports on the CDW-G 2011 Cloud Computing Tracking Poll (<http://newsroom.cdwg.com/features/feature-05-26-11.html>), which showed that "the vast majority of higher education institutions are using some form of cloud technology, though most don't seem to know it." Thirty-four percent of respondents identified their institutions as cloud adopters, "but a full 82 percent reported that their institutions use one or more technologies that are based in the cloud."

The survey involved 1,200 IT professionals in small, medium, and large businesses; federal, state, and local government agencies; health care organizations; and K-12 and higher education institutions. Here are some of the

major findings. First, business and higher education lead the adoption of cloud computing with 37 percent and 34 percent, respectively; health care is at 30 percent; and the lowest adoption percentage is small business, 21 percent. Cloud applications are email, file storage, web conferencing, online learning, and video conferencing. The top five services across all the organizations are Gmail, 34 percent; Google Docs, 29 percent; Microsoft Live Meeting, 29 percent; WebEx, 28 percent; and GoToMeeting, 24 percent.

Of those using cloud services, 8 percent said that they have already successfully reduced costs, with the average reported savings 21 percent. For higher education, 76 percent had average savings of 21 percent; for health care, 88 percent had average savings of 21 percent. The top three roadblocks to cloud computing were: security (41 percent), costs (40 percent), and privacy regulation/requirement compliance concerns (26 percent). Both higher education and health care projected increased use in the next five years.

Why Use Cloud Computing in Higher Education? The economies of scale, no capital expenditures, and on-demand services are three primary reasons higher education is examining the use of cloud computing. The obvious uses are the ability to share documents, edit collaboratively, and effectively manage versions of documents, presentations, media sources for online courses, syllabi, publications, and research datasets. The ability to conduct large-scale research studies, using unique computational software for analyses, is another obvious use.

Here are some examples of clouds used in higher education provided in the 2009 *Horizon Report* (Johnson et al., 2009):

- University of Illinois Cloud Testbed: www.cs.illinois.edu/news/articles.php?id=2008Jul29-352
- University of Wisconsin at Madison Open Sciences: www.opensciencegrid.org
- North Carolina State University Virtual Computing Lab: <http://vcl.ncsu.edu>

Thomas Edison School of Nursing uses cloud computing, specifically Google Docs, to develop, offer, and manage course content for all online nursing programs. Students can access and view content from any computer or mobile device. Thomas Edison presented this work at the Rutgers University 29th International Conference on Nursing Technology. (Contact the School of Nursing at nursing@tesc.edu.)

How Might You Use Cloud Computing in Health Care? In a recent publication titled *Healthcare & the Cloud* (2011), Easylink Services (www.easylink.com) provides the following examples of cloud applications:

- Email-based faxing (increased post-acute admissions; improved HIPAA compliance)
- Online drug usage portal (Colorado Prescription Drug Monitoring Program where physicians can look up narcotic drug prescriptions for individual files in the state)
- ePrescription services across organizations
- Data management and performance analytics (Surgical IS Analytics where one can examine and compare OR costs, usage, supply, expense)

Health ATM, which uses integrated Google cloud services, provides the underserved with access to health information. The services provided

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Sidebar. To Learn More About Cloud Computing

Bristow, R., Dodds, T., Northam, R. & Plugge, L. (2010, May/June). Cloud computing and the power to choose. *Educause Review*, 4(3), 14-30.

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include gMail, Google Calendar, Google News for Health Information and Education, Google Contacts, Google Maps, and Google Health (personal health record) (Botts, Thomas, Noamani, & Horan, 2010). (Contact nathan.botts@cgu.edu for more information.)

The Wellness Cloud (Yang, Chiang, Lui, Wen, & Chuang, 2010) is a prototype of how the cloud can be used to promote wellness, with patients communicating and accessing data from smartphones or laptops. The services include a daily diary of one's wellness program, recommendations for lifestyle changes, social network services with family, friends, and providers, alerts for medical issues, and "using location and context aware technology to delivery appropriate health promotion aid services information to clients," such as weather conditions for joggers or the smog index for those with asthma or COPD. (Contact yang.peiching@iir.csie.ncku.edu.tw for more information.)

A recent article (Beyers, 2010) identified three examples of cloud computing in health care:


- Johns Hopkins University School of Public Health: calculating differential gene expressions in large RNA sequencing datasets
- Three independent radiation oncology medical practices share clinical decision support system and consultation (BreastNet, AZ Breast Cancer Specialists, and AZ Institute for Breast Health Foundation)
- Sharp Community Medical Group Collaborative Care Solution: clinical decision support tools for 640 practicing physicians.

Cloud Computing in Your Future: What Steps Should You Take? According to the Pew Internet and American Life's Future of Cloud Computing study (Anderson & Rainie, 2010), a majority (71 percent) of technology experts project that "they will live mostly in the cloud" by 2020 using networked devices instead of desktop computers. Others believe a cloud-desktop hybrid will exist until certain barriers are addressed, security and privacy in particular. The report concludes: "The very essence of the idea of cloud computing continues to evolve, as does every aspect of the internet; it is difficult to predict what will happen because there are continuous adjustments to new realities and limitations, but we know that the drive to gain access to information everywhere and the rapid evolution of the tools to do this will continue to bring massive change" (p. 22).

Now that you have the basics of cloud computing and some examples, it is time for you to approach your organization and find out what cloud computing opportunities are available. I would suggest you contact your IT or Computing Services Department. Here are some questions you can ask:

- What cloud computing services are available? What are the costs?
- How do the university/college and the service provider ensure security and manage identity information? (Suess & Morooney, 2009)
- What are their views on the pros and cons of using cloud services?
- Are there plans to include more cloud services?
- Have any cost analyses to examine potential savings from using cloud services been performed?

- How can nursing be included in plans for the future?

More information is in the Sidebar. And, as always, I hope to hear from you. How are you using cloud services in your institution for education, research, or practice applications? I can be reached via Facebook, or email me at Diane.Skiba@ucdenver.edu. 

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